What is claim is:

1. A vibration motor comprising:

(a) a rotor having an unbalanced load;

(b) a stator having a plurality of coils having different phases respectively;

(c) a motor driver coupled with the coils and rotating said rotor, said motor driver including;

(c-1) a starting-circuit for applying starting torque to said vibration motor;

(c-2) a back-electromotive-force(BEMF)-detecting circuit for detecting BEMF of each phase of said vibration motor and outputing a BEMF detecting signal corresponding to the BEMF;

(c-3) an output-driving circuit having;

a timing-generating circuit for producing at least one signal to switch an ON-OFF state sequentially for the coils based on the BEMF detecting signal,

(c-4) a speed-controlling circuit having a reference-cycle-generating circuit for generating a reference cycle signal and a cycle-comparing circuit for comparing a cycle of the reference cycle signal with a cycle of the BEMF detecting signal so that an ON-OFF period to power said coils is effected responsive to output from said speed controlling circuit.

2. The vibration motor of claim 1, wherein said speed-controlling circuit outputs a FAST signal corresponding to a difference between the cycle of the BEMF detecting signal and the cycle of the reference cycle signal when the cycle of the BEMF detecting signal is shorter than that of the reference cycle signal so that the ON-OFF period to power said coils is effected during a FAST signal

period of said FAST signal.

3. The vibration motor of claim 2, wherein said output-driving circuit further comprises a gain-adjusting circuit which outputs a signal to stop powering to the coils during a period in proportion to the FAST signal period.

4. The vibration motor of claim 1, wherein said motor driver comprises a one chip semiconductor device, and a starting frequency of said starting circuit is produced based on a signal of a reference oscillator formed in the one chip semiconductor device.

5. The vibration motor of claim 1, wherein said motor driver comprises a one chip semiconductor device, and the reference cycle signal of said speed controlling circuit is produced based on a signal of a reference oscillator formed in the one chip semiconductor device.

6. The vibration motor of claim 1, wherein the reference cycle signal of said speed controlling circuit is produced based on a reference clock supplied from outside said motor.

7. The vibration motor of claim 1, wherein the reference cycle signal of said speed controlling circuit is variable by a direct current voltage supplied from outside said motor.

8. The vibration motor of claim 1,

wherein said speed controlling circuit has a structure which receives a reference clock from a reference oscillator as an input signal and produces the

reference cycle signal by a counter which is set at an arbitrary count number,

the reference-cycle-generating circuit has a count number setting circuit which receives an N bit signal and can set the arbitrary count number by modifying the N bit signal, whereby the reference-cycle-generating circuit outputs the reference cycle signal.

9. The vibration motor of claim 1, wherein a starting frequency of said starting circuit is produced based on a signal of a reference oscillator, and the reference cycle signal of said speed controlling circuit is also produced based on the signal of the reference oscillator.

10. The vibration motor of claim 1, wherein said motor driver comprises a structure for shorting output stages of every phase of said vibration motor.

11. The vibration motor of claim 1, wherein said motor driver comprises a structure for rotating said vibration motor forward and in reverse.

12. The vibration motor of claim 1, wherein said motor driver comprises a structure for breaking a driving current for said vibration motor and breaking a supplied current for every circuit forming said motor driver simultaneously.

13. The vibration motor of claim 1, wherein said motor driver is provided in a system-control-integrated-circuit employed in an apparatus having said vibration motor.

14. An apparatus using a vibration motor:

said vibration motor comprising:

(a) a rotor having an unbalanced load;

(b) a stator having a plurality of coils having different phases respectively;

(c) a motor driver coupled with the coils and rotating said rotor, said motor driver including;

(c-1) a starting-circuit for applying starting torque to said vibration motor;

(c-2) a back-electromotive-force(BEMF)-detecting circuit for detecting BEMF of each phase of said vibration motor and outputting a BEMF detecting signal corresponding to the BEMF;

(c-3) an output-driving circuit having;

a timing-generating circuit for producing at least one signal to switch an ON-OFF state sequentially for the coils based on the BEMF detecting signal,

(c-4) a speed-controlling circuit having a reference-cycle-generating circuit for generating a reference cycle signal and a cycle-comparing circuit for comparing a cycle of the reference cycle signal with a cycle of the BEMF detecting signal so that an ON-OFF period to power said coils is effected responsive to output from said cycle comparing circuit.

15. An apparatus using a vibration motor according to claim 14, wherein said speed-controlling circuit outputs a FAST signal corresponding to a difference between the cycle of the BEMF detecting signal and the cycle of the reference cycle signal when the cycle of the BEMF detecting signal is shorter than that of the reference cycle signal so that the ON-OFF period to power said coils is effected during a FAST signal period of said FAST signal.

16. The apparatus of claim 15, wherein said output-driving circuit further comprises a gain-adjusting circuit which outputs a signal to stop powering to the coils during a period in proportion to the FAST signal period.

17. The apparatus of claim 14, wherein said motor driver comprises a one chip semiconductor device, and a starting frequency of said starting circuit is produced based on a signal of a reference oscillator formed in the one chip semiconductor device.

18. The apparatus of claim 14, wherein said motor driver comprises a one chip semiconductor device, and the reference cycle signal of said speed controlling circuit is produced based on a signal of a reference oscillator formed in the one chip semiconductor device.

19. The apparatus of claim 14, wherein the reference cycle signal of said speed controlling circuit is produced based on a reference clock supplied from outside said motor.

20. The apparatus of claim 14, wherein the reference cycle signal of said speed controlling circuit is variable by a direct current voltage supplied from outside said motor.

21. The apparatus of claim 14,

wherein said speed controlling circuit has a structure which receives a reference clock from a reference oscillator as an input signal and produces the reference cycle signal by a counter which is set at an arbitrary count number,

the reference-cycle-generating circuit has a count number setting circuit which

receives an N bit signal and can set the arbitrary count number by modifying the N bit signal, whereby the reference-cycle-generating circuit outputs the reference cycle signal.

22. The apparatus of claim 14, wherein a starting frequency of said starting circuit is produced based on a signal of a reference oscillator, and the reference cycle signal of said speed controlling circuit is also produced based on the signal of the reference oscillator.

23. The apparatus of claim 14, wherein said motor driver comprises a structure for shorting output stages of every phase of said vibration motor.

24. The apparatus of claim 14, wherein said motor driver comprises a structure for rotating said vibration motor forward and in reverse.

25. The apparatus of claim 14, wherein said motor driver comprises a structure for breaking a driving current for said vibration motor and breaking a supplied current for every circuit forming said motor driver simultaneously.

26. The apparatus of claim 14, wherein said motor driver is provided in a system-control-integrated-circuit employed in an apparatus having said vibration motor.

27. The apparatus of claim 14, wherein said apparatus is an information apparatus.

EP 0 903 845 A2